Forest Health Protection
Pacific Southwest Region

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To: Stephen Prokop, Superintendent, Redwood National Park

Subject: Biological evaluation update of Sudden Oak Death management treatments at Redwood National Park (FHP Report No. N16-08)

Introduction

In the summer of 2014, Redwood National Park and University of California Cooperative Extension personnel discovered two new infestations of *Phytophthora ramorum*, causal agent of Sudden Oak Death (SOD) in the Redwood Creek area of Redwood National Park. The first infestation (the "Bridge Creek infestation") was located the area where Bridge Creek empties into Redwood Creek (T.9N, R.2E, NE ¼ of NE ¼ of Sec. 7). The second infestation (the "Bond/44 Creek infestation") was located along both sides of Redwood Creek between Bond and 44 Creeks (T.10N, R.1E, Sec. 25 and SW ¼ of Sec 24). Followup surveys and sampling efforts provided additional details regarding the composition and distribution of vegetation in the areas, the sizes of the infestations, and the distribution of mortality. On September 18, 2014, I documented this information in USFS Forest Health Protection Biological Evaluation Report No. N14-04-Revised. Several management recommendations were made to reduce future damage and slow the spread of the pathogen, including 1) felling or killing with herbicides all tanoak and bay within the two areas of infestation and in a 100-meter buffer zone around each area, 2) treating the stumps of tanoak and bay with herbicides (imazapyr or glyphosate) immediately after cutting to reduce sprouting, 3) conducting intensive early *P. ramorum* detection surveys around the treatment zones, and 4) treating as quickly as possible any new *P. ramorum* infestations that are identified outside of the initial treatment zones, following the same specifications as in Recommendations # 1 and 2 above.

It was recognized from the outset that the treatments that were recommended would be difficult to implement, and in all likelihood, would neither eradicate nor completely contain the disease. However, because at the very least they would significantly slow down the spread of the pathogen by reducing inoculum and the number of nearby trees that were available to become infected, I wholeheartedly supported funding the implementation of these measures through the Cooperative Forest Insect and Disease Suppression Program between the USFS and the Department of the Interior. At the time, I stressed that success of the project would largely rest on continued monitoring and rapid treatment of any new infestations according to Recommendations 3 and 4 above.

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Implementation and Monitoring of SOD Management Treatments

With the rapid infusion of necessary funds, treatments in both areas were completed in two distinct phases according to the specifications in Recommendations #1 and 2. In Phase 1, tanoak and bay in the two sites were treated with injections of Imazapyr herbicide to cause mortality in the diseased trees and in healthy host trees in 100-meter buffer areas around individual infected trees and clusters of infected trees. These "Phase 1" treatments were completed at the Bridge Creek site in October 2014 and at the Bond/44 Creek site in April 2015. However, as the treatments were completed, additional infected tanoak and bay were noticed outside of the treatment zones. This triggered a round of new "Phase 2" surveys and treatments in the new infested areas and associated 100-meter buffer zones. These were completed by August, 2015- very fast! All told, the treatment at Bridge Creek covered approximately 165 acres (94 acres for Phase 1 and 71 acres for Phase 2) and treatment at the Bond/44 Creek site covered approximately 120 acres (58 acres for Phase 1 and 61 acres for Phase 2). Response to the herbicide was excellent, and the treated areas exhibited a high degree of mortality.

Additional surveys are being conducted this year to determine if the pathogen has spread to areas within 400-meters of the Phase 1 and Phase 2 treatment sites. A 30-meter grid of cells was overlaid on a map of the 400-meter buffer zone around each of the two sites. The sampling intensity was greatest in the 100-meter zone closest to the treatment, while fewer samples were taken in the outer 400-meter zone. Figure 1 shows the sampling design for the Bond/44 Creek infestation area. The crew was instructed to sample at the relative intensities shown on the map, but to never ignore symptomatic hosts regardless of location. In addition, because the distribution of targeted host species on site sometimes did not correlate to sample locations indicated on the map, the crew was instructed to move sample points as necessary, particularly in the 200 to 400-meter bands, where sampling intensities and clustering was more pronounced.

While the sampling crew is still collecting data at the Bridge Creek infestation site, the pathogen has already been detected in host trees outside of the treated areas at both treatment sites. Approximately two dozen detections have been made at each site. However, most are within 100 meters of the edge of the existing treatment zones. Detections that are 100-200-meters away are mostly within in the band of riparian vegetation along Redwood Creek and its primary tributaries. This is not surprising given the greater incidence of bay laurel trees in the riparian zone. So far, the pathogen has not been detected 200-400 meters from the treatment edge. While it's still possible that the pathogen may be found that far out by the time the sampling is completed, any such occurrences will most likely be very limited in number. In summary, while the extension of the disease upslope from treatment zones is mostly confined to within 100-meters of the existing treatment zone, occurrences of the disease out to 200 meters of the treatment zone are limited to the riparian zone along Redwood Creek and other site tributaries.

Recommendations and Conclusions

Redwood National Park is seeking new funds to treat additional acres around the newly discovered infection sites. In response to the monitoring data, Park staff proposes to

implement a new round of herbicide treatment of tanoak and bay laurel out to 200 meters beyond the newly identified infestation areas. Although the final samples are still being collected at the Bridge Creek site, project coordinator Leonel Arguello estimates that the proposed treatment will cover an area of approximately 382 acres, at a cost of $95,500 ($250/acre). This treatment covers 155 acres at Bridge Creek (43 acres of infestation plus 112 acres of buffer) and 227 acres at the Bond/44 Creek site (45 acres of infestation plus 182 acres of buffer). Figure 2 shows the locations and layout of the proposed treatments.

While the proposal to implement a new round of treatments is still being reviewed by Park management, this action makes sense if the intent is to continue the slow-the spread efforts that were initiated two years ago. Survey data collected to date showed that most new disease detections were within 100 meters of infested trees, and almost all were within 200 meters. Increasing the width of the buffer zones from 100 to 200 meters should therefore do a much better job of containing the pathogen, and will greatly limit the occurrence of new detections in the future.

So far, Park personnel have done an excellent job of following through with Recommendations 3 and 4 from the 2014 report- "conducting intensive early *P. ramorum* detection surveys around the treatment zones", and "treating as quickly as possible any new *P. ramorum* infestations that are identified outside of the initial treatment zones". Continued surveys and timely application of followup treatments are essential to the success of the slow-the spread effort that was initiated two years ago. Because this endeavor cannot succeed without continued intensive monitoring, Leonel Arguello included an additional $30,000 in the funding request to cover the cost of two technicians to perform the necessary surveys and to process collected vegetation samples and data.

The total funding request for this project is thus:

Treatment (382 acres at $250/acre)	$95,500
Monitoring/surveys	30,000
Total-	$125,500

In conclusion, the staff at Redwood National Park, and Leonel Arguello in particular, are to be commended for the speed and thoroughness with which they have implemented both the treatment and monitoring responses to the Sudden Oak Death infestations in the Park. I continue to wholeheartedly support this effort, and recommend that appropriate funding be continued.

If you have any questions regarding this biological evaluation report or need additional assistance, please feel free to contact me at 530-226-2436.

/s/ Pete Angwin

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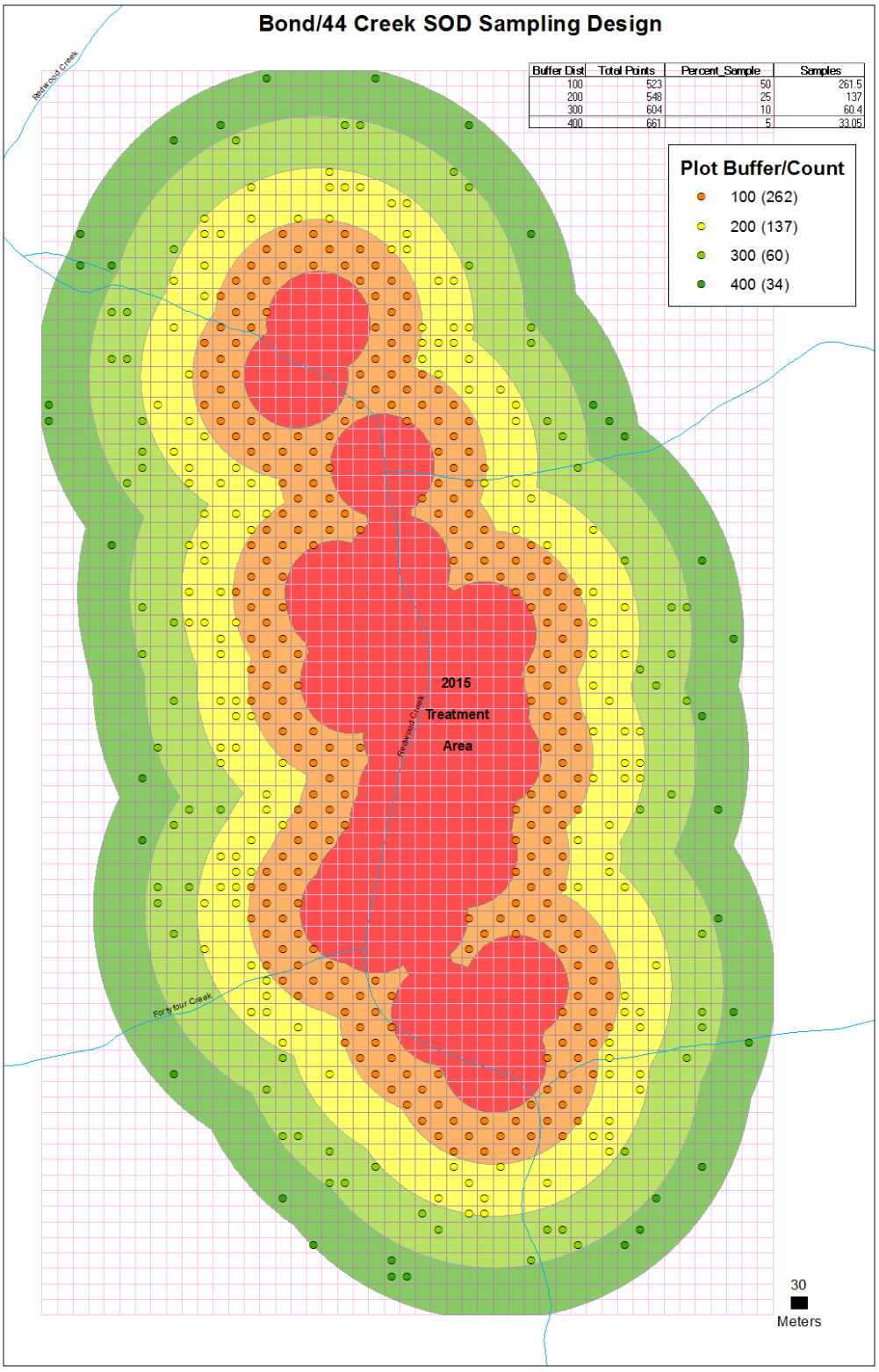

Figure 1. Post-treatment sampling design for the Bond/44 Creek treatment site at Redwood National Park. Note- sample design was the same for the Bridge Creek site.

Figure 2.

Proposed Redwood Creek SOD Treatment 2016
Bond/44 Creek site North; Bridge Creek site South